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(54) **METHODS AND APPARATUS FOR DISRUPTER RECOVERY**

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F42B 33/06 (2006.01)

(52) **U.S. Cl.**
CPC ***F41A 25/26*** (2013.01); *F42B 33/067* (2013.01)

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USPC 89/42.01, 1.13, 37.1, 37.04, 37.05, 89/40.02, 40.05, 40.06, 40.14, 37.01; 86/50; 102/401, 402, 403; 42/94
See application file for complete search history.

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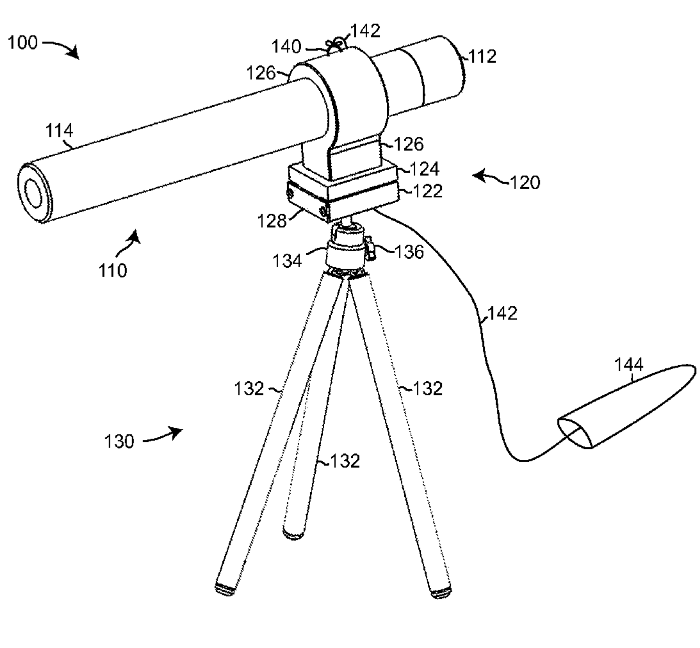
(57) **ABSTRACT**

A recovery system for recovering a disrupter after the disrupter has been fired to launch a projectile toward an explosive device. The recovery system includes a retainer that couples to the barrel of the disrupter, a slide that couples to the retainer, and a base that couples to a support. The slide removeably couples to the base. Responsive to a recoil force of firing the disrupter, the slide decouples from the base, and the disrupter, the slide, and the retainer moves away from the base and the support in a direction opposite a direction of travel of the projectile thereby completely separating the slide from the base. The disrupter may be recovered after separation from the base. The recovery system may further include a plunger that extends while the slide is removeably coupled to the base to retain the slide coupled to the base prior to firing the disrupter. Responsive to firing the disrupter, the plunger retracts to facilitate decoupling of the slide from the base.

15 Claims, 3 Drawing Sheets



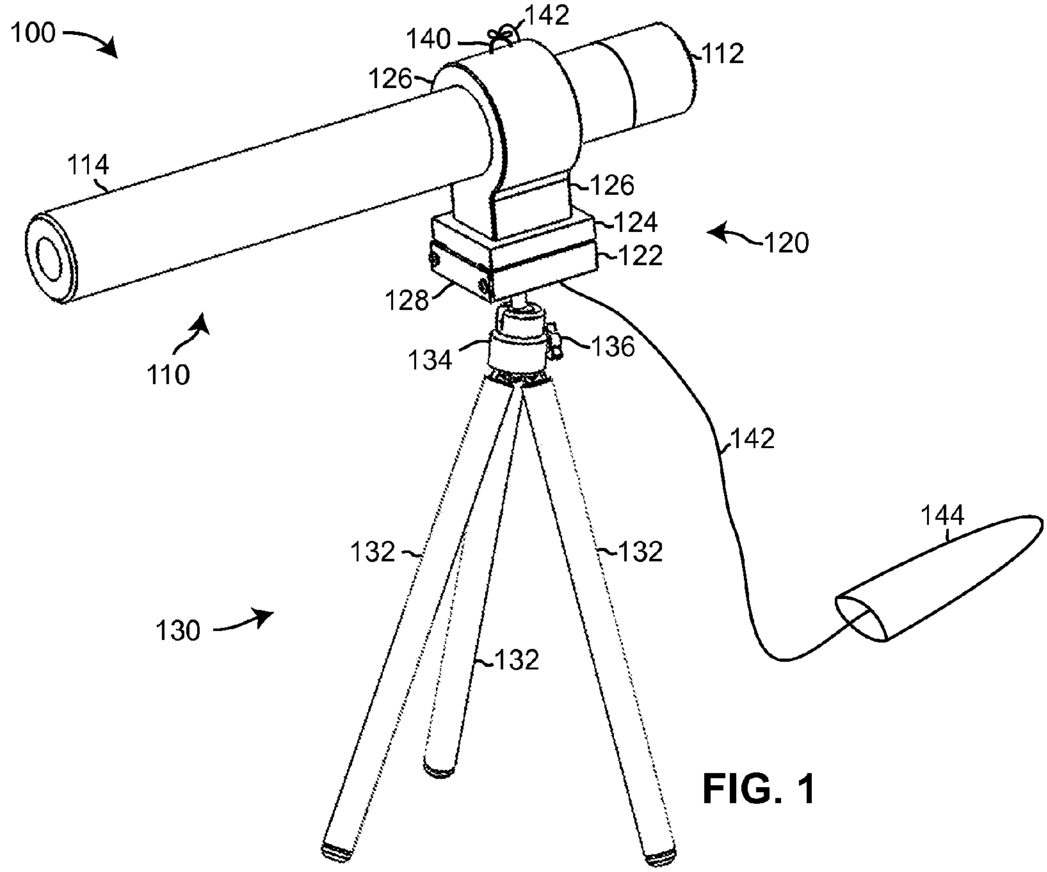

100
140
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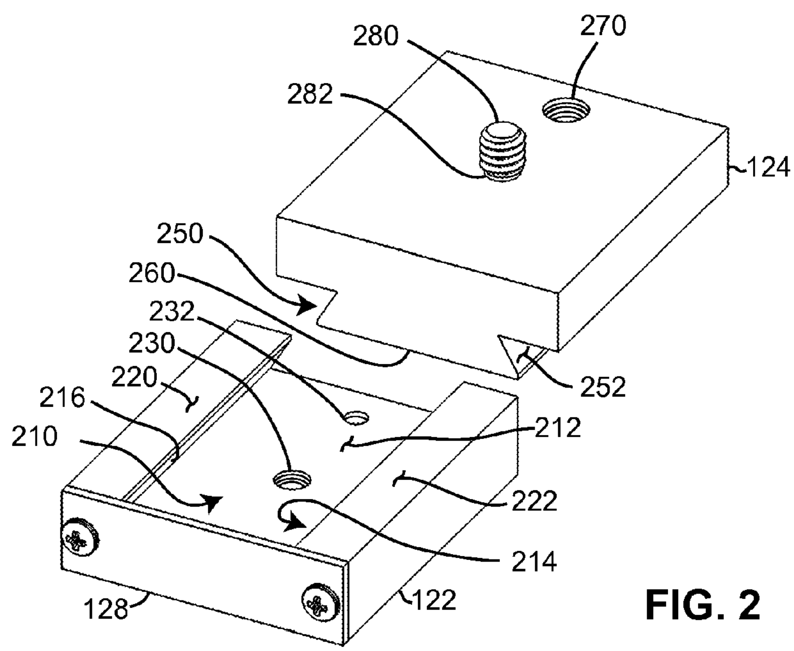
FIG. 1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128
122

FIG. 2

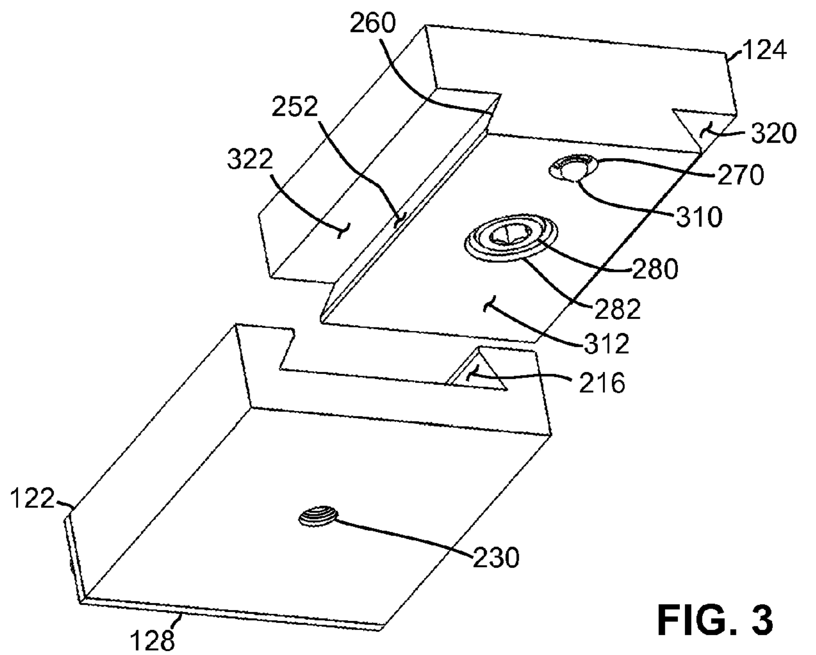
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FIG. 3

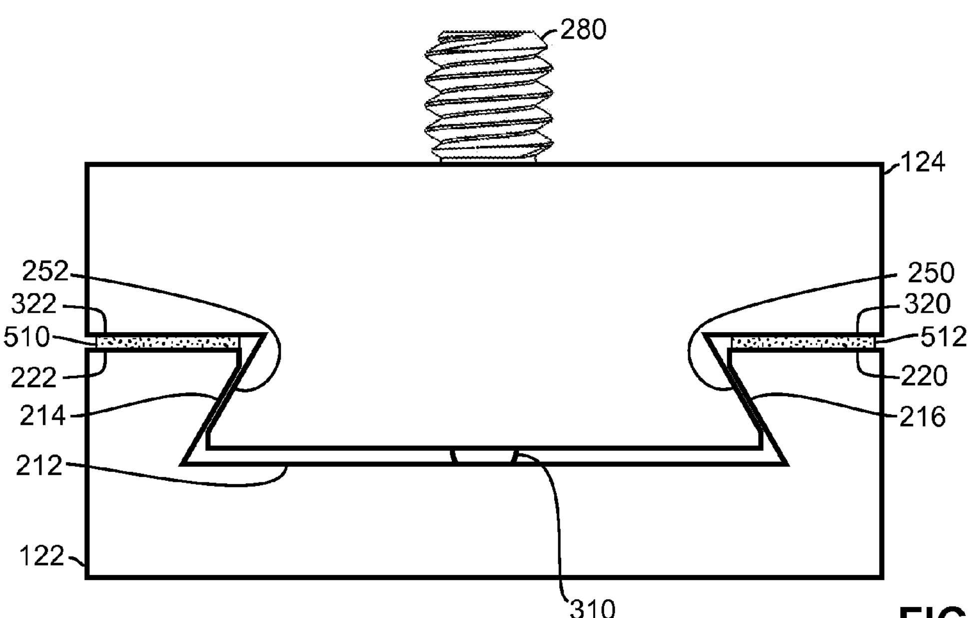
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FIG. 4

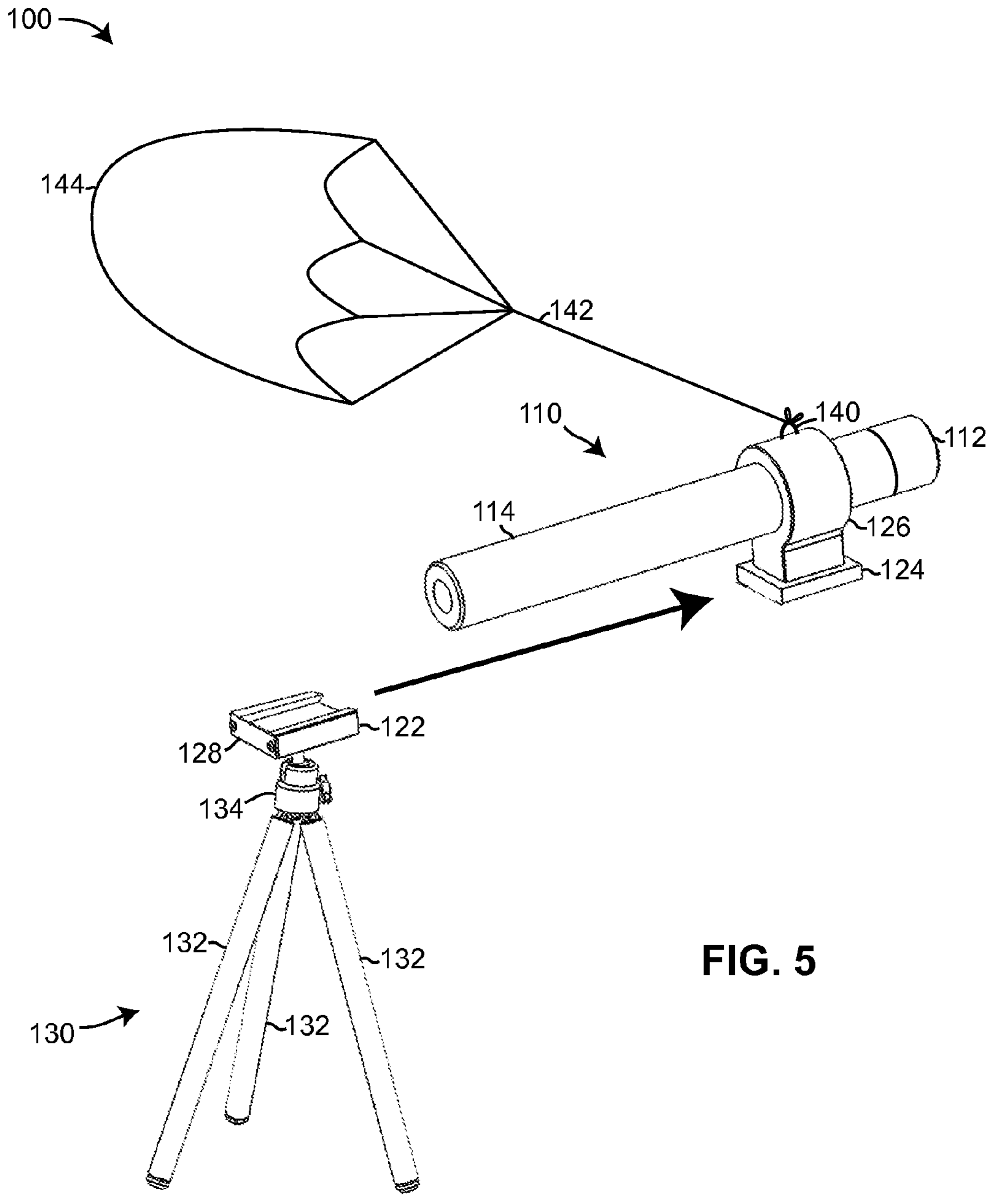

FIG. 5

METHODS AND APPARATUS FOR DISRUPTER RECOVERY

FIELD OF THE INVENTION

Embodiments of the present invention relate to disrupters, the aiming and support of disrupters prior to firing, and the recovery of disrupters after being fired.

BACKGROUND OF THE INVENTION

A disrupter launches (e.g., fires, propels, hurls) a projectile (e.g., bullet, water column, shot) at an explosive device (e.g., bomb, improvised explosive device) to disrupt (e.g., disable, destroy, incapacitate) the explosive device. Users of disrupters may benefit from a disrupter system that facilitates positioning (e.g., aiming) and supporting the disrupter prior to firing and recovering (e.g., getting back) the disrupter after firing.

BRIEF DESCRIPTION OF THE DRAWING

Embodiments of the present invention will now be further described with reference to the drawing, wherein like designations denote like elements, and:

FIG. **1** is a plan perspective view of a disrupter system according to various aspects of the present invention;

FIG. **2** is a perspective plan view of the front, top, and right side of a slide and a base of the recovery system of FIG. **1** while separated;

FIG. **3** is a perspective plan view of the back, bottom, and right side of the slide and the base of the recovery system of FIG. **1** while separated;

FIG. **4** is a rear plan view of the slide and the base of the recovery system of FIG. **1** while removeably coupled; and

FIG. **5** is a plan perspective view of the disrupter system of FIG. **1** after firing the disrupter.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A disrupter launches a projectile toward an explosive device to disrupt the explosive device. A disrupter system facilitates positioning the disrupter prior to launching the projectile so that the barrel and the trajectory of the projectile are oriented toward the explosive device. A disrupter system further facilitates recovery of the disrupter after firing the disrupter. Firing the disrupter results in a force of recoil operating on the disrupter. The force of recoil moves the disrupter, generally rapidly, from its position prior to firing the disrupter.

The disrupter system of the present invention performs the functions of a disrupter system in such a manner that the disrupter may include a muzzle brake attached to the muzzle of the barrel of the disrupter without interfering with the operation of the disrupter system. The muzzle brake may be structurally be larger (e.g., larger diameter) than the diameter of the barrel of the disrupter without interfering with the recovery operation of the disrupter after firing.

According to various aspects of the present invention, a disrupter system enables the disrupter to separate from the support that holds (e.g., supports) and positions the disrupter prior to firing the disrupter. The disrupter separates from the support responsive to the force of recoil. The disrupter system enables the disrupter to separate from the support to increase safety of operating the disrupter and to facilitate recovery of the disrupter.

Separation increases safety by leaving the support in its pre-firing position after firing the disrupter. If the disrupter does not separate from the support, the recoil force that rapidly moves the disrupter would also rapidly move the support possibly causing injury and damage as it twists through the air.

Separation of the disrupter from the support further permits the operator of the disrupter to more predictably select the direction in which the disrupter will move responsive to the recoil force. Separation of the disrupter from the support at an interface (e.g., boundary) between the disrupter and the support reduces the likelihood of having unpredictable forces applied by the support on the disrupter due to contact of the support with the ground. Whereas the terrain and slipperiness of the ground may change from one site (e.g., location) to another the interface that decouples between the disrupter and the support is consist for each operation of the disrupter, so the separation of the disrupter and movement of the disrupter after separation due to the recoil force is more consistent in different circumstances and more predictable. Predictability of movement of the disrupter responsive to the recoil force permits an operator to select a direction of flight of the disrupter in which the disrupter will not be damaged or cause damage.

Separation of the disrupter from the support further facilitates predictable deployment of an aerodynamic brake to slow the velocity of travel and the distance of travel of the disrupter responsive to the recoil force. If the disrupter does not separate from the support, the support may interfere with deployment of an aerodynamic brake thereby making recovery less predictable. If the disrupter does not separate from the support, the less predictable flight path of the disrupter makes it more difficult to reliably deploy an aerodynamic brake, limit the velocity (e.g., speed) of movement of the disrupter, and limit the distance of travel of the disrupter.

In an implementation, disrupter system **100** includes disrupter **110**, recovery system **120**, and support **130**.

Disrupter **110** includes barrel **114** and firing mechanism **112**. Disrupter **110** performs the functions of a disrupter discussed above. To operate disrupter **110** to disable an explosive device, a projectile (not shown) is placed inside of barrel **114**. A charge (e.g., pyrotechnic, propellant) is place between the projectile and firing mechanism **112**. Firing mechanism **112** ignites (e.g., fires, burns) the charge so that a rapidly expanding gas produced by the burning charge pushes (e.g., propels) the projectile out of barrel **114** toward the explosive device.

The projectile must be expelled (e.g., launched, propelled) from barrel **114** with sufficient force to strike the explosive device to disable or destroy the explosive device. The force of launch may be equivalent to the force of launching a bullet from a conventional firearm, such as a shot gun. Launching the projectile results in a force opposite the direction of travel of the projectile that is referred to above and herein as a recoil force or a force of recoil. The recoil force acts on the disrupter and any object coupled to the disrupter to move the disrupter in the direction opposite the direction of travel of the projectile.

Barrel **114** includes any conventional disrupter barrel. Firing mechanism **112** includes any conventional firing mechanism. Disrupter **110** includes any conventional disrupter including any attachments and/or accessories that may be coupled (e.g., attached) to disrupter **110**, including muzzle brakes, fire suppressors, sights for aiming, and aiming devices.

A support includes any conventional support (e.g., rest, vise, pod, tripod, bag) for supporting disrupter **110** and recovery system **120**. A support includes any conventional articulated structures for positioning (e.g., orienting) disrupter **110** in direction. A direction of orientation may include any direction with respect to any reference. For example, a direction of orientation of disrupter **110** may include up, down, left, right, forward, rearward, and any position (e.g., angle) in between with respect to support **130**. An implementation of an articulated structure for positioning includes positioner **134**.

In an implementation, support **130** includes legs **130**, positioner **134**, and knob **136**.

Support **130** supports (e.g., holds) the weight of disrupter **110** and recover system **120** while disrupter **110** is positioned prior to firing disrupter **110**. Support **130** supports disrupter **110** and recover system **120** while disrupter **110** is oriented in any position as discussed above. Support **130** may be stationary before, during, and/or after firing disrupter **110**. Support **130** may have sufficient inertia to not move at all, or not move substantially, or remain upright, even when disrupter **110** and/or recover system **120** is subjected to a force that results from firing a projectile from disrupter **110**. Positioner **134** may change is orientation with respect to legs **132** and therefore with respect to the ground to permit positioning of disrupter **110** while legs **132** remain in fixed positions. Knob **136** may be used to release (e.g., free) positioner **134** to move to position disrupter **110**. Knob **136** may be used to tighten (e.g., fix) positioner **134** so that disrupter **110** no longer changes its position, but remains in a fixed position to aim disrupter **110** in a direction. Positioner **134** may couple to recover system **120** using any conventional coupling.

A recover system may operate to reduce transmission of a force that acts on disrupter **110** to support **130**. A recover system may facilitate the separation of disrupter **110** from support **130** to reduce an amount of force transferred from disrupter **110** to support **130**. A source of force that acts on disrupter **110** includes a force that occurs as a result of (e.g., incident to) launching a projectile (e.g., recoil force). A recover system may cooperate with support **130** and disrupter **110** to position disrupter **110** prior to launching a projectile. A recover system may cooperate with support **130** and disrupter **110** to aim disrupter **110** toward an explosive device prior to launching a projectile.

A recovery system operates to provide consistent separation of disrupter **110** from support **130** for repeated operations of disrupter **110**. A recovery system operates to provide a consistent trajectory of movement for disrupter **110** responsive to a force of recoil. A recovery system operates to allow an operator to select a direction of movement of the disrupter **110** responsive to a recoil force. A recovery system may include an aerodynamic brake that deploys responsive to movement of disrupter **110**. A recovery system operates to provide consistent deployment of an aerodynamic brake for repeated operations of disrupter **110**. A recovery system operates to improve the safe operation of disrupter **110**. A recovery system operates to prohibit decoupling of disrupter **110** form support **130** prior to firing disrupter **110**. A recovery system operates to facilitate separation of disrupter **110** from support **130** for storage, transport, positioning of support **130**, and/or loading of disrupter **110** for launching a projectile.

In an implementation, recovery system **120** performs the functions of a recover system discussed above. Recovery system **120** includes base **122**, slide **124**, and retainer **126**. Base **122** couples to positioner **134** using any conventional coupling. Base **122** removeably couples to slide **124**. Base **122** may couple to slide **124** prior to launching a projectile. Base **122** may remain coupled to slide **124** while disrupter **110** is positioned (e.g., aimed). Base **122** may remain coupled to slide **124** as a projectile is being launch and as the force of recoil acts on the disrupter **110** and recovery system **120** up to a predetermined magnitude of force. The predetermined magnitude of force is determined by a force of interference provided by plunger **310** as discussed below. As the force of recoil exceeds the predetermined magnitude, side **124** begins to move with respect to base **122** so that slide **124** separates from base **122**. The force of recoil that acts on disrupter **110** acts on slide **124** via retainer **126** to decouple slide **124** from base **122**.

The separation of base **122** and base **122** limits the transfer of the recoil force from disrupter **110** to support **130**. Decreasing the predetermined magnitude of the force required to separate slide **124** from base **122** decreases the amount of recoil force transferred from disrupter **110** to support **130**.

Retainer **126** couples to disrupter **110**, preferably barrel **114** of disrupter **110**. Retainer **126** remains coupled to barrel **114** before, during, and after a projectile is launched from disrupter **110**. In an implementation, retainer **126** is omitted and slide **124** is coupled directly to disrupter **110** and slide **124** performs the functions of slide **124** and retainer **126** discussed herein. The portion of retainer **126** that couples to barrel **114** may be different for different types of types, makes, sizes, and shapes of disrupters, while the coupling to slide **124** may be consistent for all version of retainer **126** thereby providing consistency in operation and manufacture of recovery system **120**.

Slide **124** couples to retainer **126** using any conventional coupling. Slide **124** remains coupled to retainer **126** before, during, and after a projectile is launched from disrupter **110**. Barrel **114** does not separate from retainer **126**. In an implementation, retainer **126** may include a passage (e.g., bore). Barrel **114** may be positioned (e.g., inserted) in the passage. Retainer **126** may couple to barrel **114** in such a manner that the interior surface of the retainer **126** clamps to (e.g., grasps, interferes with) an outer surface of barrel **114** to couple to barrel **114**. A diameter of the passage may be suitable for clamping to a particular part of barrel **114** to provide better holding ability and balancing of the barrel on support **130** while in use. An interior surface of the passage may include any structure (e.g., texture, protrusions) to facilitate clamping to barrel **114**. Barrel **114** may include specific structures (e.g., bores, protrusions) and retainer **126** or the passage of retainer **126** may include matching (e.g., mated) structures for coupling.

In another implementation, retainer **126** is implemented in two pieces. A bottom portion of retainer **126** couples to slide **124** in any conventional way. Barrel **114** is positioned in the bottom portion of retainer **126**. The top portion of retainer **126** is positioned over barrel **114**. Coupling the top portion of retainer **126** to the bottom portion of retainer **126** couples barrel **114** to retainer **126** so that barrel **114** remains coupled to retainer **126** before, during, and after firing disrupter **110**. A two-piece retainer **126** may be used when barrel **114** does not have a substantially constant diameter along the length thereof due to tapering, areas of greater diameter and/or attachments positioned on barrel **114**.

Retainer **126** may couple to barrel **114** and recovery system **120** may perform the functions of a recovery system without requiring barrel to fit (e.g., slip, pass) through the passage in retainer **126**, so barrel **114** does not need to have a consistent shape (e.g., round) along its length. Further, accessories such as a muzzle brake may be coupled to barrel **114** without interfering with the functions of recovery system **120**.

Base **122** includes groove (e.g., mortise) **210**, cap (e.g., plate) **128**, bore **230**, cavity (e.g., hollow, recess) **232**, and surfaces **212**, **214**, **216**, **220**, and **222**. Slide **124** includes protrusion (e.g., tenon) **260**, bore **282**, bolt **280**, bore **270**, plunger **310**, and surfaces **312**, **250**, **252**, **320**, and **322**.

Protrusion **260** slides (e.g., moves) in groove **210**. Protrusion **260** enters groove **210** through an opening in a rear, with respect to FIG. **2** and the direction of flight of a launched projectile, wall of base **122**. A top wall of base **122** includes an opening that defines a length of groove **210**. Protrusion **260** enters groove **210** via the opening in the rear wall and moves along groove **210** while a portion of slide **124** extends through the opening in the top wall. Protrusion **260** continues to move forward in groove **210** until a portion of slide **124** contacts a wall (e.g., front wall with respect to the direction of travel of a projectile) of base **122** opposite the rear wall. Cap **128** forms a portion of the front wall of base **122**. Cap **128** stops forward movement of protrusion **260** in groove **210** and forward movement of slide **124** with respect to base **122**.

Surfaces **250** and **252** of slide **124** and surfaces **214** and **216** are formed at an angle with respect to the plane of movement of protrusion **260** with respect to groove **210**. Interference of surfaces **214** and **216** with surfaces **252** and **250** respectively, prohibits protrusion **260** from exiting groove **210** via the opening in the top of base **122**. In other words, surfaces **214**, **216**, **250**, and **252** are angle so that while protrusion **260** is positioned in groove **210**, interference between surfaces **214** and **216** with surfaces **252** and **250** respectively prohibits movement of slide **124** away from base **122** in a vertical, with respect to FIG. **2**, direction. Cap **128** prohibits protrusion from exiting groove **210** in a forward direction. Protrusion **260** may exit groove **210** only by moving in a rearward direction (e.g., away from cap **128** and with respect to the direction of travel of the projectile) with respect to base **122** so that protrusion **260** exits groove **210** via the opening in the rear wall of base **122**. The limitations in movement imposed by (e.g., that result from) cap **128** and surfaces **214**, **216**, **250**, and **252** constrain the movement of slide **124** to base **122** to along the plane of surface **212** and rearwardly.

Because the force of recoil is directed in the rearward direction, the recoil force may act to move protrusion **260** out of groove **210** subject to the force applied by plunger **310** as discussed herein. Movement of protrusion **260** completely out of groove **210** results in complete separation of slide **124** from base **122**.

Moving protrusion **260** forward in groove **210** until slide **124** contacts the front wall of base **122** positions plunger **310** over cavity **232**. Plunger **310** is biased by a resilient force to extend beyond surface **312**. When extended, plunger **310** enters cavity **232**.

Plunger **310** operates to retain slide **124** coupled to base **122**. As discussed above, a resilient force acts to move plunger **310** outward from surface **312** and into cavity **232**. Interference between plunger **310** with the sides of cavity **232** operates to retain protrusion **260** in groove **210** and slide **124** coupled to base **122**. However, a force of recoil exerts a force of such a magnitude on plunger **310** that it overcomes the resilient force of plunger **310** and forces plunger **310** to retract from cavity **232** and into bore **270** thereby freeing slide **124** to decouple and separate from base **122**. The resilient force exerted on plunger **310** is proportional to the

amount (e.g., magnitude) of recoil force required to move plunger **310** into bore **270** and out of cavity **232**.

In the absence of a recoil force, before disrupter **110** is fired, the resilient force that extends plunger **310** provides sufficient force to retain plunger **310** in cavity **232** while disrupter **110**, and therefore cap **128**, is positioned in an upward direction, with respect to FIG. **1**. When disrupter **110** is oriented toward the ground (e.g., downward), cap **128** retains slide **124** in grove **210**. When disrupter **110** is oriented in a level positioned, slight forces of friction (e.g., drag) in addition to plunger **310**, maintain slide **124** in grove **210**. When disrupter **110** is oriented upward, gravity acts on disrupter **110** and slide **124** to move protrusion **260** out of groove **210** via the opening in the rear wall of base **122**. Absent plunger **310**, gravity would separate slide **124** and base **122** while disrupter **110** is positioned in an upward direction. However, the force exerted by plunger **310** and the force of interference between plunger **310** and the sides of cavity **232** is sufficient to retain plunger **310** in cavity **232**, protrusion **260** in groove **210**, and slide **124** coupled to base **122**. The resilient force exerted on plunger **310** is sufficient so that a force of gravity cannot pull protrusion **260** from groove **210** while disrupter **110** is oriented upward. However, because a recoil force is greater than the force of gravity, the recoil force overcomes the resilient force of plunger **310** so that plunger **310** retracts into bore **270** thereby freeing protrusion **260** to move out of groove **210** such that slide **124** separates and moves away from base **122**.

In another implementation, plunger **310** couples to base **122** and cavity **232** is formed in slider **124** and cooperate to perform the coupling and releasing functions discussed herein.

In another implementation, plunger **310** may be omitted when in use the muzzle of disrupter **110** will only be oriented level with respect to gravity or downward (e.g., closer to ground than base **122**, angled toward ground) toward an explosive device and not upward where gravity may act to pull slide **124** away from base **122**.

Separation of slide **124** from base **122** responsive to a recoil force limits the transfer of the recoil force to support **130**. Limiting the transfer of the recoil force to support **130** leaves support **130** in place during and after launching a projectile instead of moving (e.g., flying) in an uncontrolled manner responsive to the recoil force. Movement of support **130** in an uncontrolled manner may result in injury or death to people, animals, or property.

Ease of movement of protrusion **260** from groove **210** and the amount of the recoil force transferred to support **130** is related to the friction between surfaces **212**, **214**, **216**, **220**, and **222** and surfaces **312**, **252**, **250**, **320**, and **322** respectively. Increased friction between surfaces **212**, **214**, **216**, **220**, and **222** and surfaces **312**, **252**, **250**, **320**, and **322** results in a greater transfer of the recoil force to the support. If surfaces **212**, **214**, **216**, **220**, and **222** and surfaces **312**, **252**, **250**, **320**, and **322** were to catch with (e.g., stick to, interfere with) each other, a sufficient amount of the recoil force could be transferred to support **130** to move and/or destabilize support **130**.

If the transfer of recoil force to support **130** is limited so that support **130** remains stable and in place, the trajectory of disrupter **110** as it moves in response to the recoil force is predictable and precautions may be made to protect against injury cause by the forceful movement of disrupter **110**. Further, knowing how and where disrupter **110** will move responsive to a recoil force permits prior planning for recovery of disrupter **110**.

The magnitude of the energy transferred from slide **124** to base **122**, and therefore support **130**, depends on the amount of energy that can be transferred from the surfaces of slide **124** to the surfaces of base **122**. Reducing the friction between surfaces **212**, **214**, **216**, **220**, and **222** and surfaces **312**, **252**, **250**, **320**, and **322** reduces the amount of energy that can be transferred from slide **124** to base **122** and to support **130**.

A slippery or low friction coating (e.g., material) between the surfaces of slide **124** and the surfaces of base **122** reduces the friction between the surfaces and the amount of recoil force transferred to support **130**. Materials that may be used for friction (e.g., drag) reducing coatings may include polytetrafluoroethylene polymers (e.g., PTFE, Teflon), polyethylene, diamond-reinforced PTFE, titanium-reinforced PTFE, and other polymers (e.g., hydrophobic polymers) that reduce drag. A friction reducing coating may be in the form of a tape where one side of the tape adheres to surface of slide **124** and the slippery surface of the tape is positioned against the opposing surface on base **122** or vise versa.

A drag reducing coating may be placed on some or all of the surfaces of base **122** and slide **124**. For example, coating only surface **322** or **222** and surface **320** or **220** reduces the fiction between base **122** and slide **124** sufficient so that protrusion **260** may exit groove **210** without destabilizing support **130**. In an application, friction reducing coating **512** is applied to surfaces **322** and **320** to reduce the friction between surfaces **322** and **222** and surfaces **320** and **220**. In other applications, a drag reducing coating may be placed between all surfaces that may contact each other such as between **322** and **222**, **252** and **214**, **212** and **312**, **216** and **250**, and **320** and **220**.

Testing has shown that applying a friction reducing coating results in a transfer of energy from disrupter **110** during firing to support **130** that is so minimal that a disrupter weighing about three pounds does not result in visible movement to the naked eye of a support that weighs about six ounces.

Preferably applying a friction reducing coating should provide a dry coating so that when disrupter **110** is used outdoors, dirt does not stick to the coating if disrupter **110** comes to rest on the ground after firing. Friction reducing coatings that are applied as a dry (e.g., not sticky, not adhesive) coating may be cleaned of dirt and/or debris by hand for proper performance in a subsequent firing. Durable coatings that apply dry may be used for many firings with minimal maintenance that may be performed in the field and rapidly between subsequent firings.

Retainer **126** couples to barrel **114** of disrupter **110**. Retainer **126** couples to barrel **114** using any conventional coupling. Retainer **126** remains coupled to barrel **114** before, during, and after launch of a projectile. Retainer **126** may be removed for storage if convenient. Retainer **126** couples to slide **124** using any conventional coupler.

In an implementation, retainer **126** includes a threaded bore (not shown). Slide **124** includes bore **282**. Bolt **280** passes through bore **282** and threads into the bore in retainer **126** to couple slide **124** to retainer **126**. Slide **124** remains coupled to retainer **126** before, during, and after launch of a projectile. Retainer **126** is not decoupled from slide **124** responsive to the recoil force of launching a projectile.

Plunger **310** may be inserted into bore **270** to position plunger **310** over cavity **232** when protrusion **260** is inserted into groove **210** and slide **124** is positioned proximate to cap **128**. Bore **270** may permit adjustment of the position and depth of penetration of plunger **310** into cavity **232** using any conventional structures. In an implementation, plunger **310** includes a threaded body that threads into bore **270** so that turning the body in one direction positions plunger **310** deeper into cavity **232** and turning the body in the opposite direction retracts plunger **310** from cavity **232**.

Recovery system **120** may include an aerodynamic brake. An aerodynamic brake may deploy responsive to movement of disrupter **110**. An aerodynamic brake may slow the speed of separation of disrupter **110** from support **130** responsive to launching a projectile. An aerodynamic brake may limit the distance traveled by disrupter **110** away from support **130** responsive to launching a projectile.

In an application the aerodynamic brake includes parachute **144**. Parachute **144** couples to anchor **140** on retainer **126**. Cord (e.g., lanyard) **142** couples parachute **144** to anchor **140**. Prior to launch, parachute **144** may be laid on the ground. Prior to launch, parachute **144** may be stowed in a container (e.g., tube) (not shown) coupled to support **130** or base **122**. The container may include an open end through which parachute **144** exits the container when deployed. A pulling force exerted by anchor **140** on cord **142** deploys parachute **144**. Movement of disrupter **110** results in anchor **140** exerting a pulling force.

In operation, retainer **126** is coupled to barrel **114**. Slide **124** is coupled to retainer **126**. Base **122** is coupled to positioner **134**. An operator loads a projectile and a pyrotechnic, usually packaged together in the form of a cartridge, into disrupter **110**. The projectile and pyrotechnic includes any conventional projectile and pyrotechnic. The operator prepares firing mechanism **112** to ignite the pyrotechnic to launch the projectile. The pyrotechnic may be ignited in any conventional manner.

The operator of disrupter system **100** inserts protrusion **260** into cavity **232** and moves slide **124** forward toward cap **128**. The operator must exert enough force when moving protrusion **260** forward in groove **210** so that plunger **310** retracts when it comes into contact with the rear edge of base **122**. Plunger **310** remains retracted and contracts surface **212** until plunger **310** is positioned over cavity **232**. Once plunger **310** is positioned over cavity **232**, plunger **310** extends into cavity **232** to retain protrusion **260** in groove **210** until a force of recoil forces plunger **310** out of cavity **232**.

The operator positions (e.g., aims) barrel **114** by loosening knob **136** and orienting barrel **114** toward the explosive device to be disrupted. Disrupter **110** may include any conventional sighting device for aiming disrupter **110** including a sight and a laser. Disrupter **110** may assume any orientation as discussed above. After aiming is completed, the operator tightens knob **136** so that disrupter **110** retains its orientation toward the explosive device.

While positioning support **130** and aiming disrupter **110**, the operator may investigate whether there are any obstacles or objects in the recoil path of disrupter **110** when it separates from support **130**. The operator may position support **130** and aim disrupter **110** in such a manner so as to reduce the likelihood of injury or damage caused by impact of disrupter **110** with an obstacle or object along the recoil trajectory of disrupter **110**.

The operator ignites the pyrotechnic to launch the projectile. The force of launching the projectile out barrel **114** causes the recoil force. The recoil force acts to move disrupter **110** in a direction opposite the direction of aiming. Because barrel **114** is oriented in the same direction that cap **128** is oriented, the force of recoil will operate to move protrusion **260** out of groove **210** via the opening in the rear wall of base **122**. Plunger **310** will, at first, resist (e.g., stop, slow down, retard) movement of protrusion **260** out of groove **210** because of the interference between plunger **310** and the sides of cavity **232**. However, as the force of recoil increases, plunger **310** will be forced into bore **270** and to withdraw from cavity **232** so that protrusion **260** moves out of groove **210**.

Rapid movement of protrusion **260** out of groove **210** permits slide **124** to rapidly separate completely from base **122**. As discussed above, friction reducing coatings **510** and **512** reduce the drag between slide **124** and base **122**, so that only a small proportion of the recoil force that acts on disrupter **110**, retainer **126**, and slide **124** is translated (e.g., transferred) to base **122** and support **130**. Support **130** remains in place without moving or with only slight movement in response to the recoil force. Support **130** does not tilt onto less its total number of legs or fall over responsive to firing disrupter **110**.

Rapid movement of disrupter **110** and thus retainer **126** applies a pulling force on cord **142**. The force on cord **142** deploys parachute **144**. Parachute **144** applies a force (e.g., drag) on disrupter **110** that retards the speed of travel of disrupter **110**. Because parachute **144** applies a drag force on disrupter **110**, parachute **144** may limit the distance traveled by disrupter **110** responsive to launching a projectile.

When disrupter **110** comes to rest after firing a projectile, the operator may recover disrupter **110** for subsequent firings.

The foregoing description discusses preferred embodiments of the present invention, which may be changed or modified without departing from the scope of the present invention as defined in the claims. Examples listed in parentheses may be used in the alternative or in any practical combination. As used in the specification and claims, the words 'comprising', 'including', and 'having' introduce an open ended statement of component structures and/or functions. In the specification and claims, the words 'a' and 'an' are used as indefinite articles meaning 'one or more'. When a descriptive phrase includes a series of nouns and/or adjectives, each successive word is intended to modify the entire combination of words preceding it. For example, a black dog house is intended to mean a house for a black dog. While for the sake of clarity of description, several specific embodiments of the invention have been described, the scope of the invention is intended to be measured by the claims as set forth below. In the claims, the term "provided" is used to definitively identify an object that not a claimed element of the invention but an object that performs the function of a workpiece that cooperates with the claimed invention. For example, in the claim "an apparatus for aiming a provided barrel, the apparatus comprising: a housing, the barrel positioned in the housing", the barrel is not a claimed element of the apparatus, but an object that cooperates with the "housing" of the "apparatus" by being positioned in the "housing".

What is claimed is:

1. A recovery system for recovering a provided disrupter after the disrupter has been fired to launch a provided projectile toward a provided explosive device, the recovery system comprising:

a retainer having a passage therethrough, a provided barrel of the disrupter positioned in the passage, the retainer coupled to the barrel such that the retainer remains coupled to the barrel before, during, and after firing the disrupter;

a slide, the slide coupled to the retainer, the slide remains coupled to the retainer before, during, and after firing the disrupter;

a base, the base coupled to a provided support, the base remains coupled to the support before, during, and after firing the disrupter;

the slide removeably couples to the base;

responsive to a recoil force of firing the disrupter, the slide decouples from the base, and the disrupter, the slide, and the retainer move away from the support in a direction opposite a direction of travel of the projectile thereby completely separating the slide from the base.

2. The recovery system of claim **1** further comprising a plunger wherein:

the plunger is coupled to one of the slide and the base;

while the slide is coupled to the base, the plunger extends to interfere with one of the base and the slide to retain the slide coupled to the base prior to firing the disrupter; and

responsive to the recoil force of firing the disrupter, the plunger retracts so that the slide decouples from the base.

3. The recovery system of claim **1** wherein:

the slide comprises a protrusion;

the base comprises a groove;

the protrusion slides into the groove to couple the slide to the base.

4. The recovery system of claim **1** further comprising an aerodynamic brake wherein:

movement of the disrupter away from the support deploys the aerodynamic brake to slow and limit movement of the disrupter.

5. The recovery system of claim **4** wherein the aerodynamic brake comprises a parachute.

6. The recovery system of claim **1** further comprising a coating for reducing friction between at least one surface of the slide and at least one surface of the base to:

facilitate separation of the slide from the base responsive to the force of recoil; and

reduce an amount of the force of recoil transferred to the support.

7. The recovery system of claim **1** wherein the interference between the plunger and the base retains the slide coupled to the base regardless of the orientation of the disrupter with respect to the support.

8. A recovery system for recovering a provided disrupter after the disrupter has been fired to launch a provided projectile toward a provided explosive device, the recovery system comprising:

a retainer having a passage therethrough, a provided barrel of the disrupter positioned in the passage, the retainer coupled to the barrel such that the retainer remains coupled to the barrel before, during, and after firing the disrupter;

a slide, the slide coupled to the retainer, the slide remains coupled to the retainer before, during, and after firing the disrupter, the slide comprising a protrusion;

a base, the base coupled to a provided support, the base remains coupled to the support before, during, and after firing the disrupter, the base comprising a groove, the groove open on a first side and a second side of the base; wherein:

the protrusion enters the groove via the opening on the first side, a side of the protrusion interferes with a side of the groove so that the protrusion cannot exit the groove via the opening on the second side, while the protrusion is positioned in the groove;

the opening on the first side is oriented in a direction opposite a direction of travel of the projectile; and responsive to a force of recoil of firing the disrupter:

the protrusion moves out of the groove via the opening in the first side to decouple the slide from the base; and

the disrupter, the slide, and the retainer move away from the support in the direction opposite the direction of travel of the projectile.

9. The recovery system of claim **8** further comprising a plunger wherein:

the plunger is coupled to one of the slide and the base;

while the protrusion is positioned in the groove, the plunger extends to interfere with one of the base and the slide to retain the protrusion in the groove prior to firing the disrupter; and

responsive to the recoil force of firing the disrupter, the plunger retracts so that the protrusion exits the groove and the slide decouples from the base.

10. The recovery system of claim **8** further comprising a coating for reducing friction between at least one surface of the slide and at least one surface of the base to:

facilitate separation of the slide from the base responsive to the force of recoil; and

reduce an amount of the force of recoil transferred to the support.

11. The recovery system of claim **8** further comprising an aerodynamic brake wherein:

movement of the disrupter away from the support deploys the aerodynamic brake to slow and limit movement of the disrupter.

12. The recovery system of claim **11** wherein the aerodynamic brake comprises a parachute.

13. The recovery system of claim **8** wherein the interference between the plunger and the side of the groove retains the slide coupled to the base regardless of the orientation of the disrupter with respect to the support.

14. A recovery system comprising:

a disrupter, the disrupter comprising a barrel, the disrupter for launching a provided projectile toward a provided explosive device to disrupt the explosive device;

a retainer having a passage therethrough, the barrel positioned in the passage, the retainer coupled to the barrel such that the retainer remains coupled to the barrel before, during, and after firing the disrupter;

a slide, the slide coupled to the retainer, the slide remains coupled to the retainer before, during, and after firing the disrupter, the slide comprising a protrusion;

a base, the base comprising a groove, the groove open on a first side and a second side of the base;

a support, the base coupled to the support, the base remains coupled to the support before, during, and after firing the disrupter; the support supports the weight of the disrupter, the retainer, the slide, and the base prior to firing the disrupter; wherein:

prior to firing:

the protrusion is positioned in the groove via the opening on the first side, a side of the protrusion interferes with a side of the groove so that the protrusion cannot exit the groove via the opening on the second side, while the protrusion is positioned in the groove;

the support supports the disrupter, the retainer, the slide, and the base for aiming the disrupter toward a provided explosive device, the support positioned upright and in a location;

the opening on the first side of the base is oriented in a direction opposite a direction of travel of the projectile

responsive to launching the projectile:

the protrusion moves out of the groove via the opening in the first side to decouple the slide from the base;

the disrupter, the retainer, and the slide move away from the base and the support in the direction opposite the direction of travel of the projectile for later recovery.

15. The recovery system of claim **14** further comprising a plunger wherein:

the plunger is coupled to one of the slide and the base;

while the protrusion is positioned in the groove, the plunger extends to interfere with one of the base and the slide to retain the protrusion in the groove prior to firing the disrupter; and

responsive to the recoil force of firing the disrupter, the plunger retracts so that the protrusion exits the groove and the slide decouples from the base.

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